REMARKS

Upon entry of the present amendment, claims 1-17 are pending, with claims 1, 7, 8 and 14 being independent. Claims 1-3 and 5 are amended. New claims 7-17 are added by virtue of this amendment. No new matter has been added.

In paragraph 2 the Examiner requests a copy of the reference to Kruger, et al., "On the Application of Non-Linear Partial Least Squares to Industrial Process Control." Applicants submit herewith a copy of this reference in the Information Disclosure Statement filed concurrently with this response.

With regard to paragraph 3, Applicants are submitting additional references in the Information Disclosure Statement filed concurrently with this response; for example many of the references listed on pages 39-41 of the specification as filed. Some of the references that are listed on pages 39-41 are not being submitted with the Information Disclosure Statement, as the omitted references are not believed to be relevant to the claims of this application, but rather disclose only basic background information.

With regard to paragraph 4, Applicants are submitting a new copy of formal drawings. Applicants note that formal drawings were previously filed in this application on August 23, 2001.

In paragraphs 5-7, the Examiner rejected claims 3-6 under 35 U.S.C. §112 second paragraph as being indefinite. Claims 3 and 5 have been amended to remove the phrase "which is so arranged" and to further clarify the features of these claims. Applicants submit that these amendments sufficiently clarify the claims and request withdrawal of the rejection of claims 3 and 5.

Applicants submit that claims 4 and 6 have sufficient clarity because each claim, when read as a whole, clearly recites a tangible processing step. Moreover, the specification at page 19, line 18 through page 20, line 10 describes multiple examples of how abnormal behavior can be identified by analyzing the residuals of the response variables. Accordingly, Applicants request withdrawal of the rejection of claims 4 and 6.

In paragraphs 8 and 9 of the office action claims 1-6 were rejected under 35 U.S.C. §101 as being directed to non-statutory subject matter. Claim 1 has been amended to recite a method of monitoring an industrial process. Applicants submit that the recited process is clearly within the technological arts. Therefore, in view of the amendments to this claim and further in view of the subsequent processing features recited in this claim, withdrawal of the rejection is respectfully requested.

In paragraphs 10-17 the Examiner rejects claims 1 to 6 under 35 U.S.C. §102 as being anticipated by Wold et al. (US 5,949,678). Applicants respectfully disagree.

The Partial Least Squares approach (PLS) is one approach used to evaluate industrial processes. It divides process measurements into cause and effect variables (predictor and response variables). A T2 chart is produced that contains information relating to the cause variables only, and two SPE (Squared Prediction Error) charts are produced: one containing information on the cause variables (SPEx) and one containing information on the effect variables (SPEy). The SPE values for the cause variables are calculated using a score vector that contains information on the cause variables. Similarly, the SPE chart for the effect variables is calculated using a score vector that contains information on the effect variables. Thus, one problem of using this standard PLS method to monitor industrial processes is that two SPE charts are required. Furthermore, by considering cause and effect variables independently in this way, then it can be difficult to establish the cause of a fault in a process. It is also possible that a fault will only be detectable in the effect variables and therefore by monitoring the cause variables alone, this fault will go undetected.

The present application provides a novel solution to the above problems with the PLS approach. This is referred to in the specification as an "extended" partial least squares method (EPLS). This method corresponds to the standard PLS approach up until the calculation of the score vectors. The extended method then includes a new additional step of calculating "generalized score vectors" from a combination of the standard "cause" and "effect" score vectors. Such a "generalized score vector" contains information on both the cause and effect variables. The calculation of the generalized scores is described in the specification at page 5

line 25 to page 6 line 9. A single SPE chart can then be produced from the generalized score vector and thus contains information on both the cause and effect variables. Advantageously, only one SPE chart is needed and by analyzing the two types of variables together it should be possible to identify precise cause-effect paths that have caused a fault.

In contrast, Wold discloses a dynamically updating standard PLS algorithm. Whenever new data is collected, loading vectors are updated using this data. This allows new values of the standard score vectors to be calculated and thus new SPE and T2 statistics. However, Wold does not disclose the subsequent calculation of "generalized score vectors" according to claim 1 of the present application, wherein the first generalized score vector describes variation of both the predictor and response variables (i.e. the cause and effect variables). Indeed, the Wold PLS algorithm will result in the production of two SPE charts, and will therefore suffer from the problems identified in the present application.

Considering now claim 1 in more detail, the features disclosed prior to the words "characterized by" are features common to both the standard PLS model, such as that of Wold, and the "extended" model of the present application. This is explained in the description at page 2 lines 11 to 27. The features disclosed after the word "characterized by" are however not disclosed in Wold. These features relate to the calculation of the generalized score vectors.

Specifically, the Examiner is correct in noting that the predictor and response matrices of 'cause' and 'effect' variables respectively of claim 1 of the present application could be considered equivalent to the matrices 'X' and 'Y' at column 9 of Wold.

With regard to the feature of claim 1 of 'decomposing the predictor and response matrices into rank one component matrices', the Examiner has cited the passage at column 10 lines 26-28. However, this passage relates to Principal Component Analysis (PCA) which is a completely separate technique to the PLS technique claimed in the present application. As such, Wold does not anticipate 'decomposing the predictor and response matrices into rank one component matrices' for PLS. Nevertheless, such steps are known in the art to be applied to PLS.

We also acknowledge that the score vectors and loading vectors of claim 1 of the present application could be considered equivalent to the score and loading vectors of the matrices 'T' and 'P' of column 9 of Wold.

However, the process of "creating a first generalized score vector which describes any significant variation of the process including variations of the predictor and response variables, and a second generalized score vector which represents the prediction error" is not anticipated by the cited portions of Wold at column 13, and nor is it anticipated by the step $t_{a, T+1}$ as argued by the Examiner. This step is part of the dynamically updating PLS algorithm disclosed in Wold (see step 7: "make a one-step-ahead forecast of scores ..." and the above discussion of the dynamically updating algorithm); is nothing whatsoever to do with the creation of generalized score vectors within the meaning of claim 1 of the present application. Wold does not disclose the creation of a generalized score vector which describes any significant variation of the process including variations of the predictor and response variables.

Regarding the Examiner's rejection of claim 2, Applicants submit that nowhere in Wold is it disclosed that generalized scores should be calculated according to the formulae given in claim 2, and in particular there is no disclosure of a score matrix $Tn = T'n - E'n$ wherein $T'n$ and $E'n$ are of the mathematical form given in claim 2.

Applicants further note that Wold does not recognize the problems of the standard PLS algorithm that have been recognized by the present Applicants, i.e. by considering cause and effect variables separately, two SPE charts are required and faults may go undetected, as discussed above. Wold therefore makes no attempt to solve these problems, and certainly makes no teaching or suggestion that generalized score vectors should be created that contain information on both cause and effect so that they may be considered together.

Finally, Applicants note that the remarks outlined above discuss the benefits of the generalized score vectors in relation to the creation of SPE and T2 charts, whereas the specification primarily discusses the creation of Q and T2 charts (a feature recited in new claim 8). However, Applicants submit that there is no inconsistency here, as one skilled in the art will

clearly understand that a single SPE chart can be calculated from the generalized scores, and that this is an important advantage of the use of generalized scores.

For at least these reasons, the subject matter of claims 1-6, and new claims 7-17 is not anticipated by Wold. Thus, Applicants request reconsideration and withdrawal of the rejection of claims 1-6, and further request allowance of all of the pending claims.

Please apply any other charges or credits to deposit account 06-1050.

Respectfully submitted,

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